Microgrid Applications in Indonesian Telcom Industries

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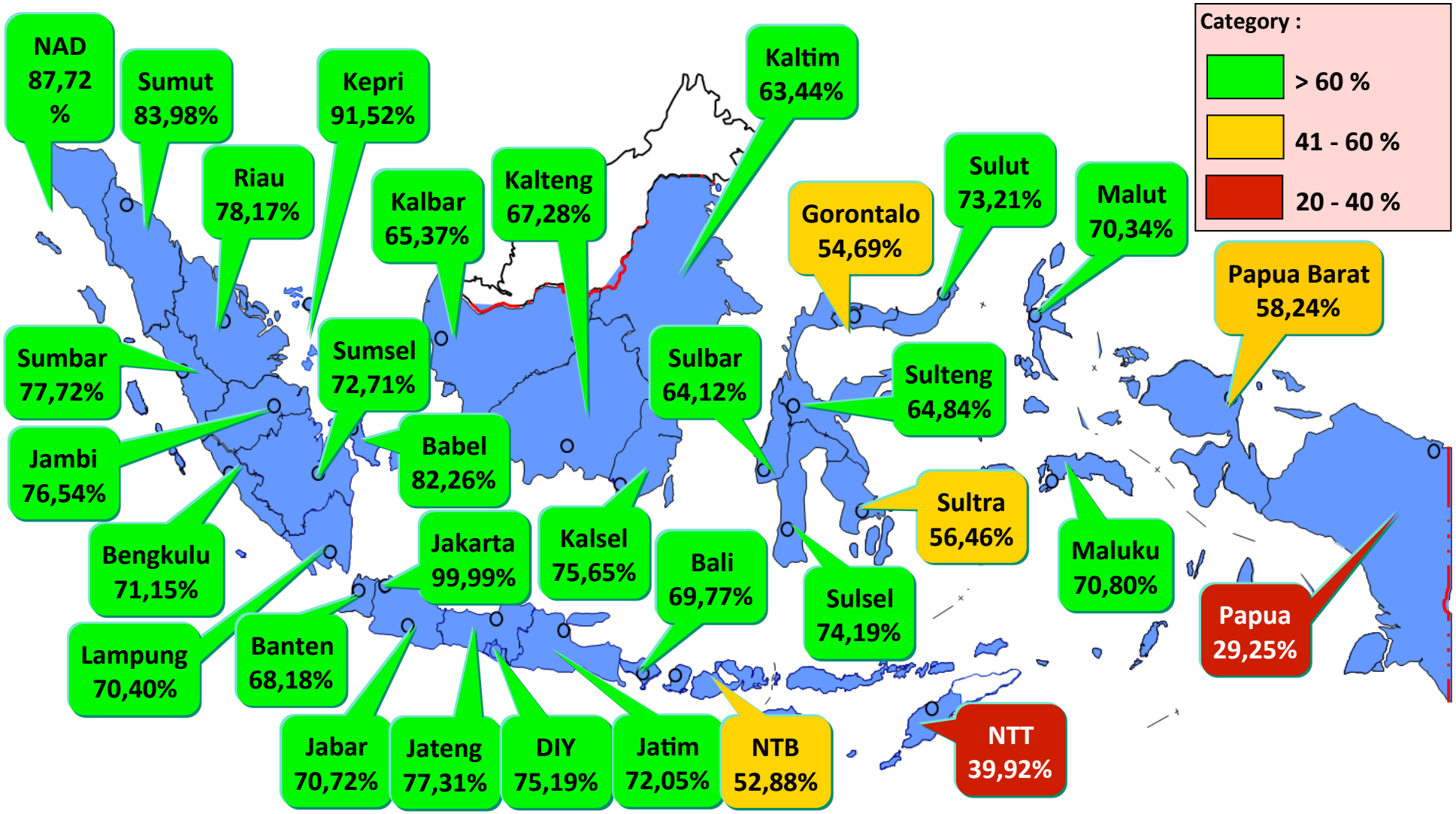
Background

- Indonesia has more than ten thousands small islands those are distributed around the equator.
- Indonesia has targeted to install more than 1000 MW wind power plants and 10000 MW solar power plants by 2025.
- There are more than six telcom operators in Indonesia.
- There are more than 100,00 Base Transceiver Stations (BTS) with power demands ranging from 750 W up to 10,000 W.
- One remote BTS usually consumes 2000 liters of diesel fuel every month.
- PT. Telkom (the biggest telcom operator) has a program to improve the reliability of the BTSs by using alternative energy sources those are available locally.
- It is reported that energy expense has became about 30% of OPEX.

Background

Population : 250 millions
GDP : 4000 USD

ELECTRIFICATION RATIO BY PROVINCE

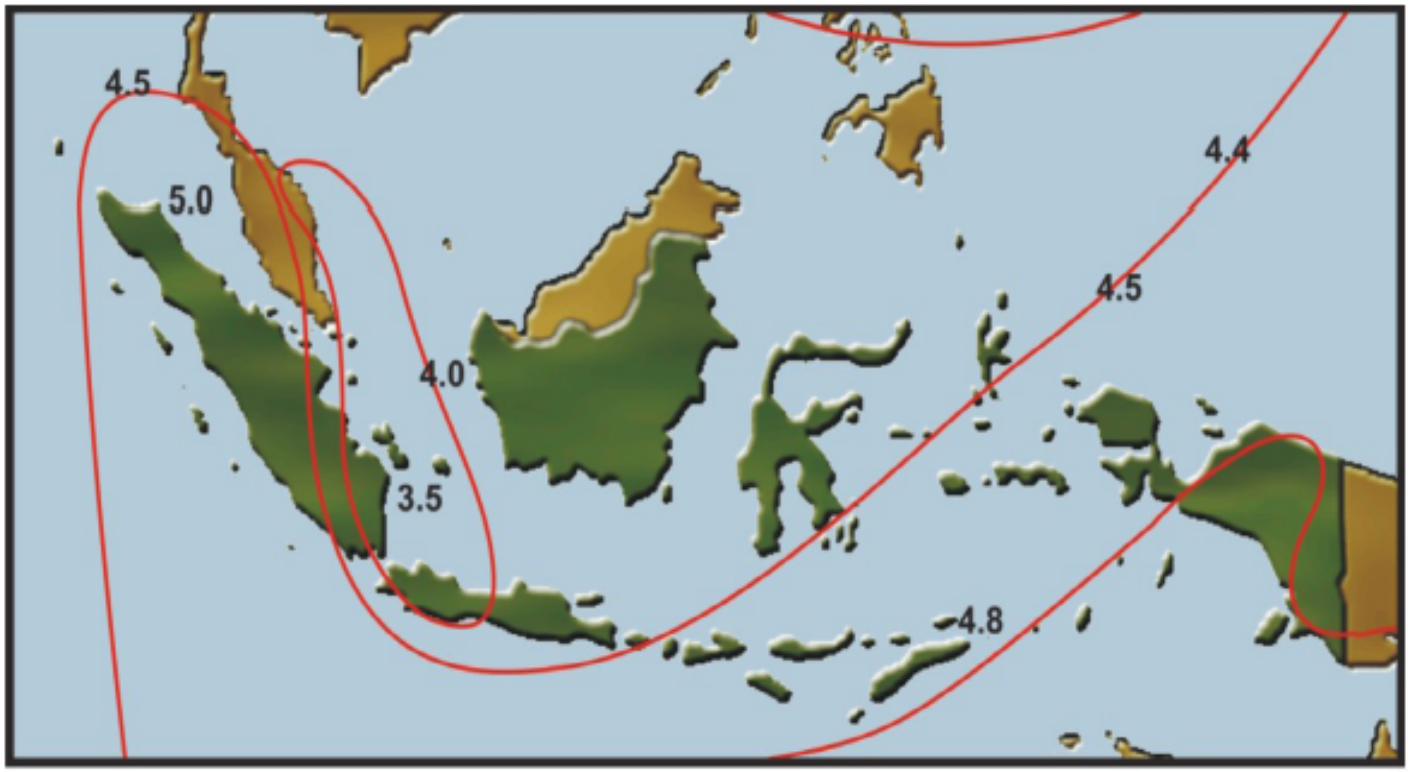


	REALIZATION (Years)						TARGET (Years)		
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Rasio Elektrifikasi	63%	64,3%	65,1%	65,8%	67,2%	72,95%	75,3%	77,65%	80,0%

Background

- Solar energy is the first choice as Indonesia is located on the equator
- It is expected that the use of wind power may reduce the system cost
- Utility line or diesel power is used as the backup.
- Several efforts to improve reliability and efficiency of telcom power system such as cyclic charging, remote feeding, fuel cells, hybrid power systems have been done.

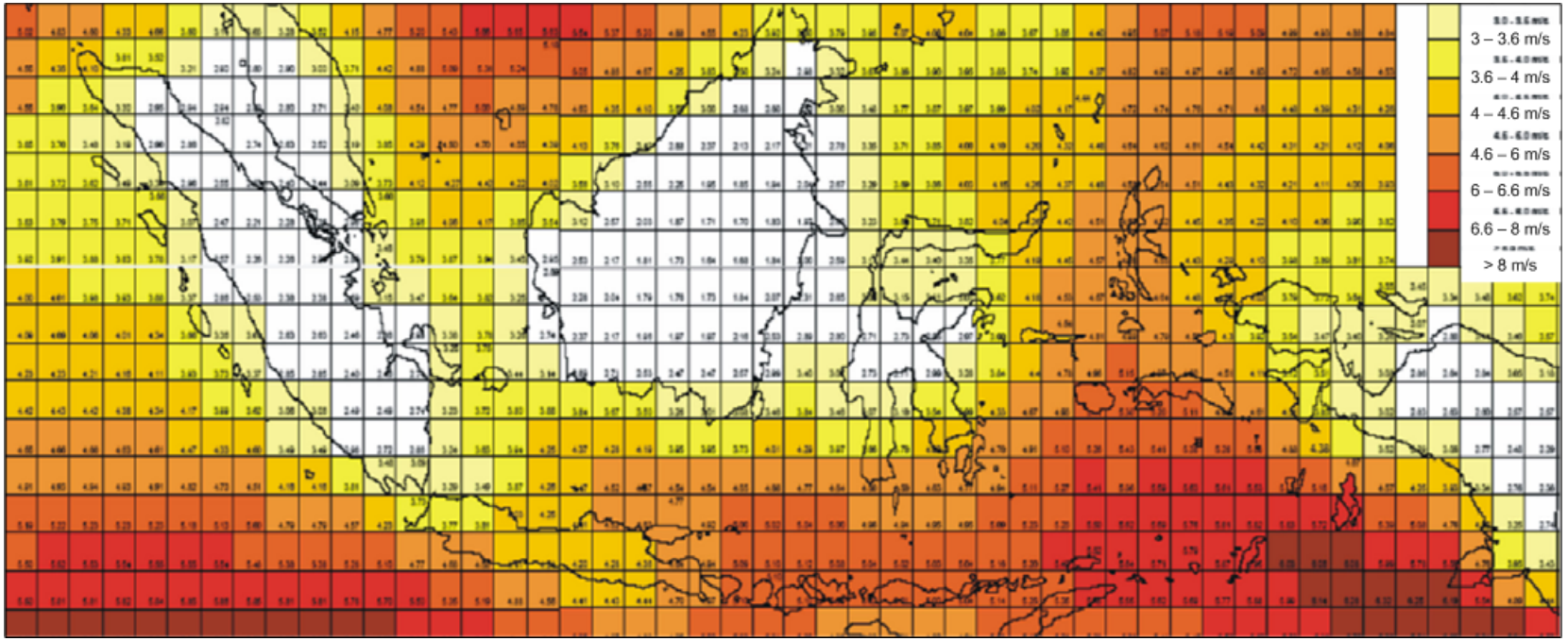
Solar Power Map



Sumber: "World Design Insolation", Solarex

Insolation in kWh/m2/day

Wind Power Map

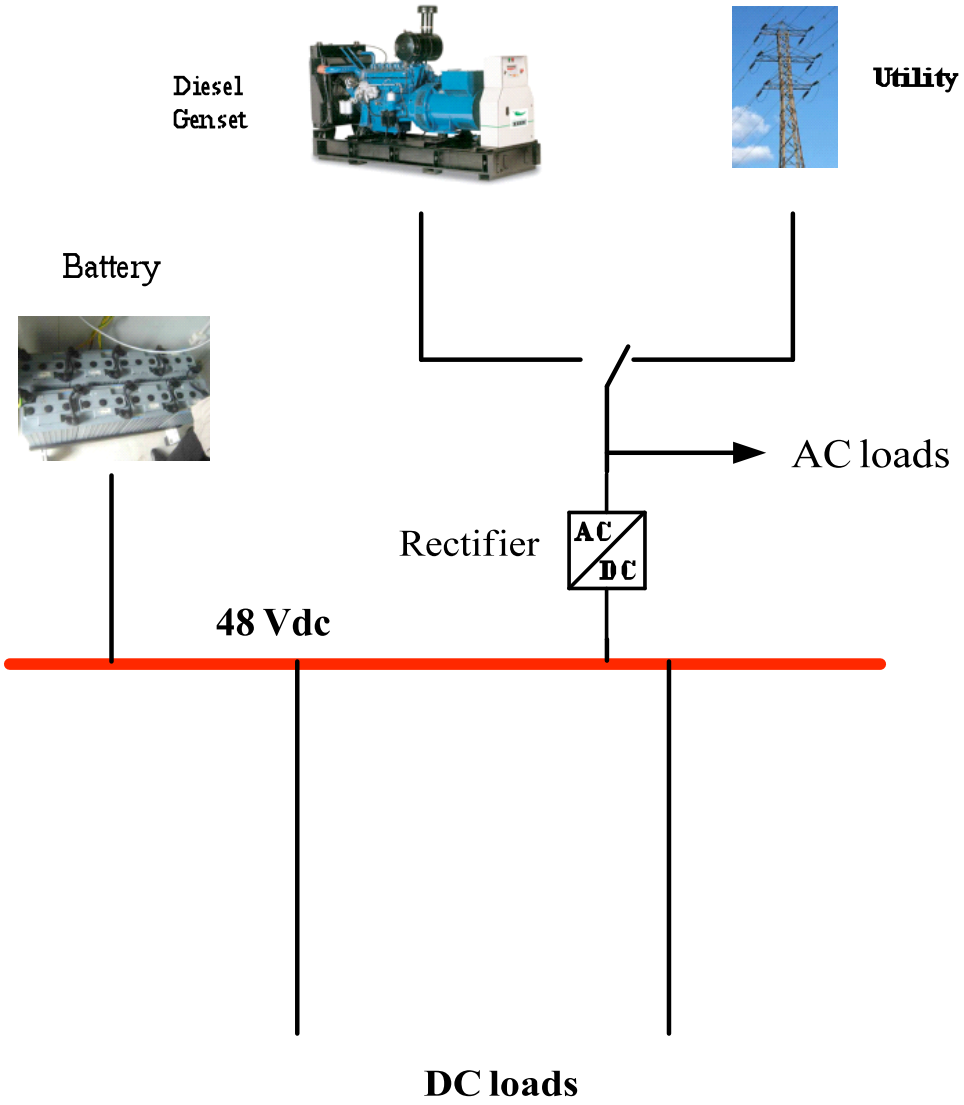


Wind power is available in east part of Indonesia

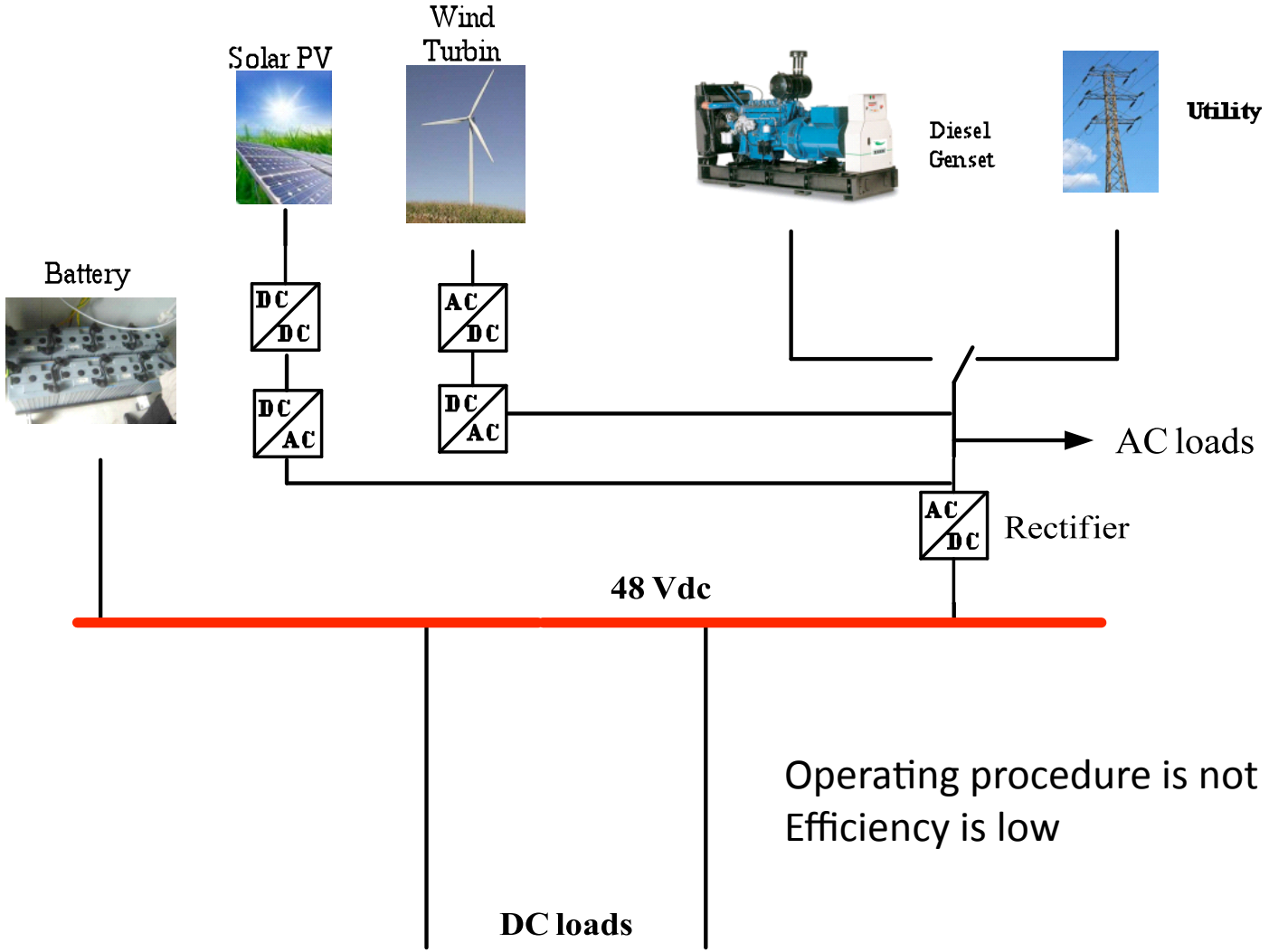
BTS Power Consumption

- Average total power consumption is about 4,000 Watt
- About 2,000 Watt is for air conditioning
- About 1,500 Watt for telecommunication equipment
- The rest is for lighting and monitoring

Conventional BTS

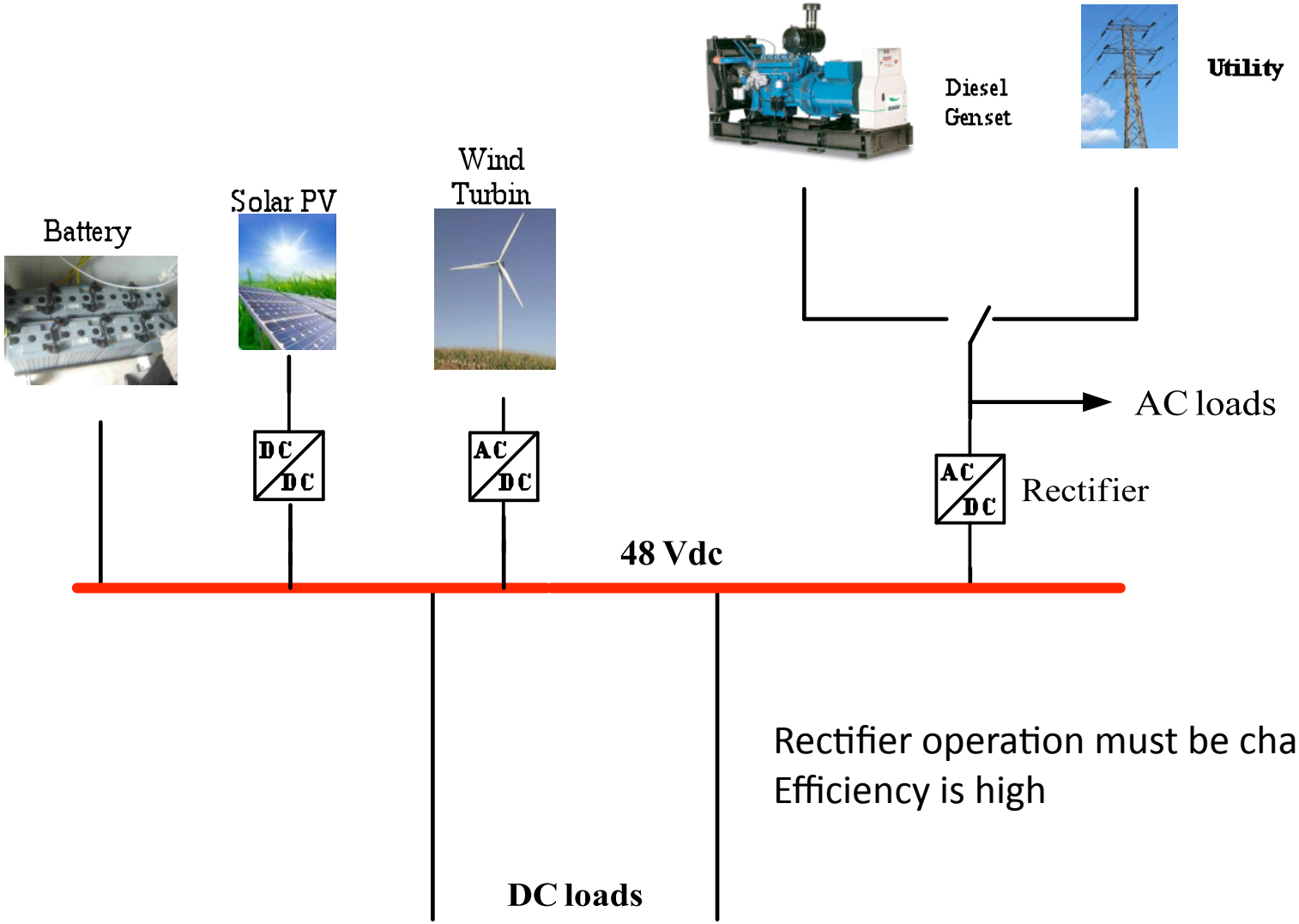


First Configuration



Operating procedure is not changed
Efficiency is low

Second Configuration



Rectifier operation must be changed
Efficiency is high

Microgrid Example

- Location : Girisari, Bali island
- Average daily energy consumption for telecommunication is 1,5kWx24h = 36 kWh
- Average wind speed is 5-6 m/s
- Average sunshine hours is about 7-8 hrs during dry season and 5-6 hrs during rainy season
- Battery backup time is 24 hours

General Specification

- Photovoltaic System : Polycristaline PV, 4.8 kWp (48 pcs, @ 100Wp)
- Battery Bank : Deep Cycle OPzV, 57.6 kWh (48 block, @ 100 Ah)
- Charge Controller : PWM, 48 Vdc, 120 Ampere,
- PV Support System : Free Standing, on top shelter for 4800 Wp
- Wind Turbine : 2500 Watt, 48 Vdc, included Charge controller
- Wind Tower : 24 meter Self Support, steel galvanize
- Protection Panel : AC and DC protection system
- Remote monitoring : Data acquisition and communication via GPRS

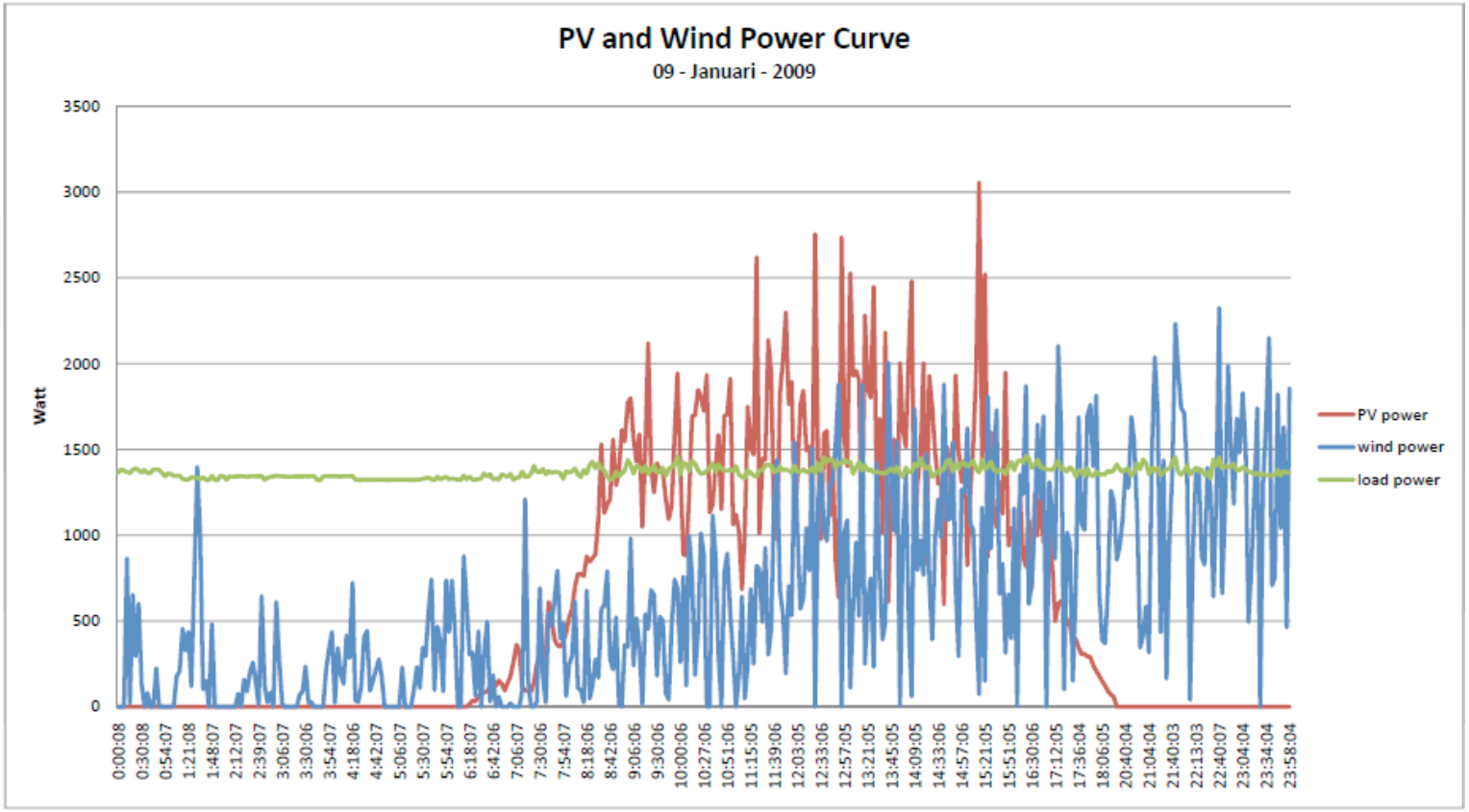
Specification of Wind Power

Type	: SKEA LPN-2500E
Rated Power	: 2500 Watt
Rotor position	: upwind
Rotor diameter	: 5.0 m
Number of blades	: 3
Blade material	: Fiberglass-reinforced
Rotor speed	: 450 rpm
Cut-in speed	: 2.5 m/s
Nominal rated speed	: 10 m/s
Generator type	: Angular type, magnet permanent
Safety system	: " *ecliptic safety by turning tail vane 90^{o} and electric brake* "
Tail length	: 2800 mm

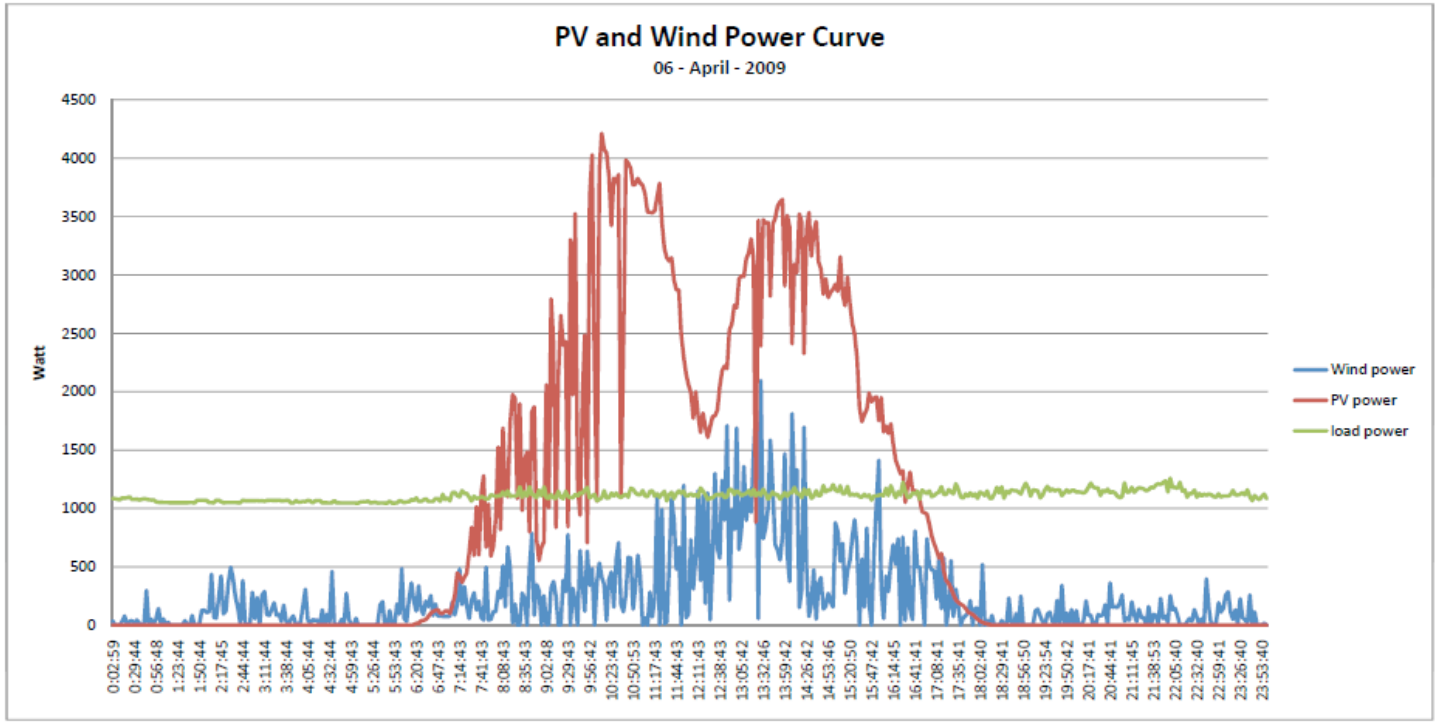
Specification of PV Module

Cell	: Polycristal
No. Of Cells and connections	: 36
Nominal Voltage	: 12 V DC
Dimension	: 1339 x 669 mm
Typical maximum power (P_{max})	: 100 Watt
Voltage at maximum power (V_{mp})	: 16.5 V
Current at maximum power (I_{mp})	: 5.90 A
Short-circuit current (I_{sc})	: 6.70 A
Open-circuit voltage (V_{oc})	: 21.8 V

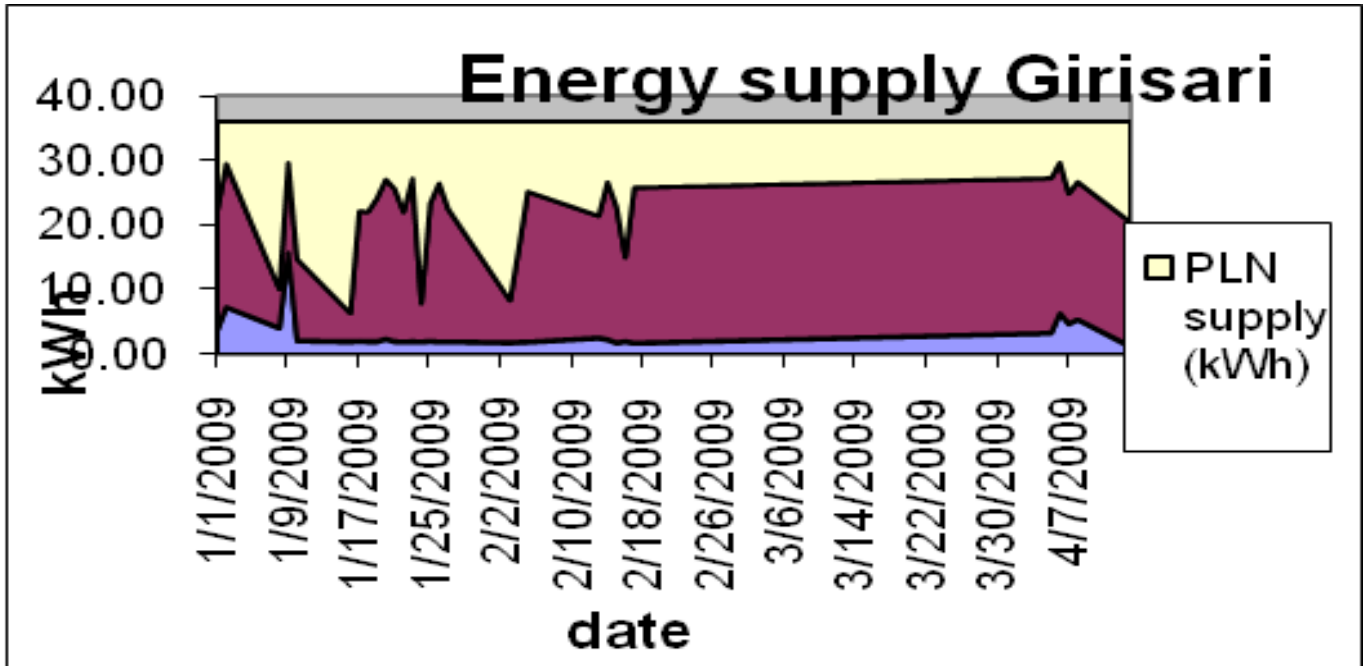
Measurement Results



Measurement Results



Energy Produced by PV, Wind & Utility



Data Analysis

- The selected location has very good sunshine hours
- The average wind speed is too low but the speed varies widely
- Wind power cannot be relied for this purpose
- After one year of operation, there are almost no significant operating problems.
- One significant problem is the broken of wind turbine because of very strong wind
- The operating data will be used to adjust the design of the next projects

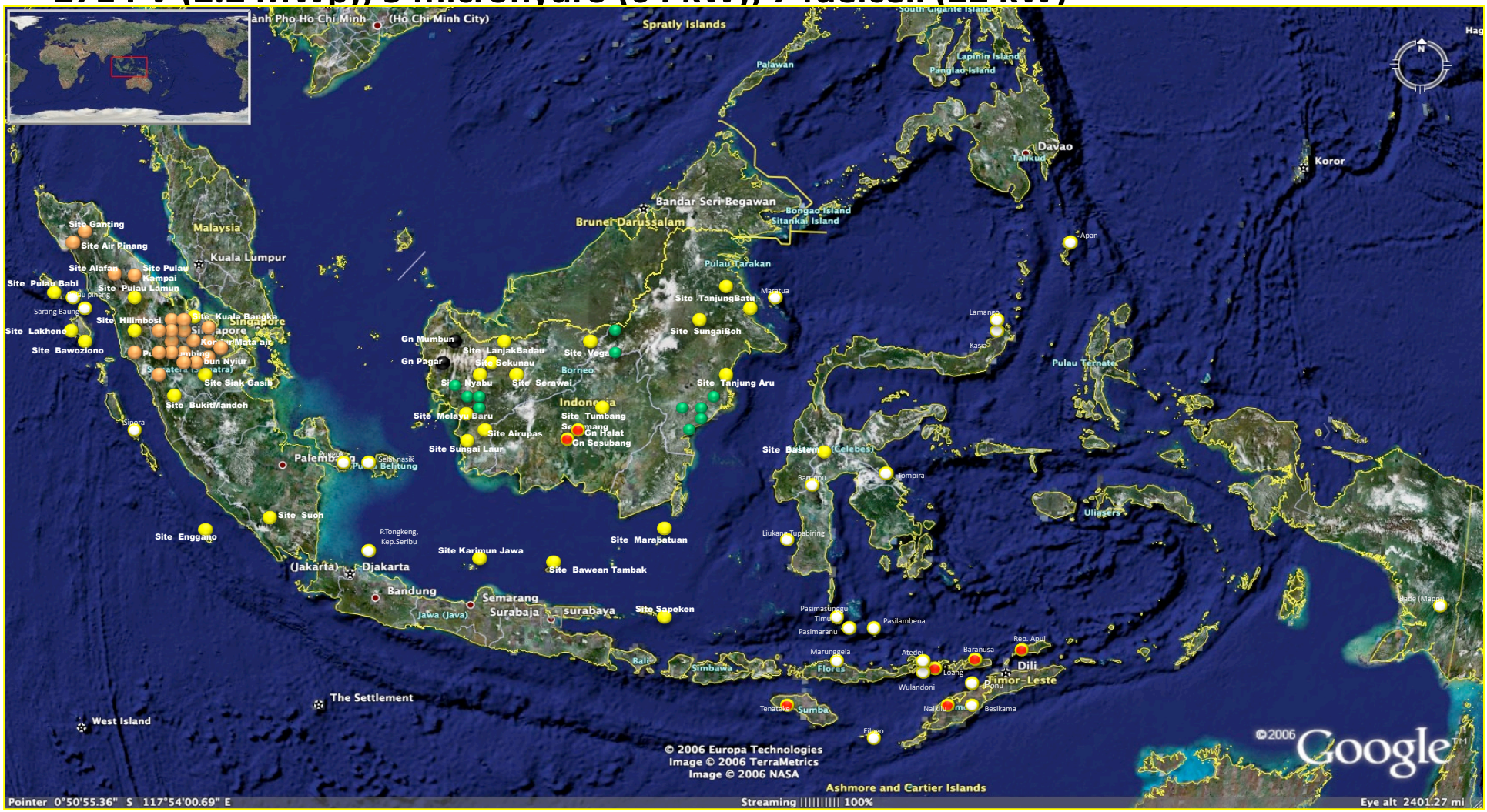
General Experiences

- Indonesian telcom industries have installed more than 300 microgrid power systems with various renewable resources such as solar, wind, microhydro, biodiesel, and fuel cell.
- Battery is the most expensive and unreliable component in microgrid power systems. Because of vandalism problem, sometimes we have to install battery under unfavorable conditions.
- At present, the contribution of wind energy is still very small.

- Optimizing the setting of state of charges of battery
- Investigating battery performance under tropical conditions

Telkomsel Green Powered BTS

271 PV (2.2 MWp); 5 microhydro (64 kW); 7 fuelcell (22 kW)



Conclusion

- Experience has shown that PV is more promising than wind power.
- Telcom companies have targeted to reduce the electrical energy consumption by 20%.
- Telcom companies have targeted to replace 2.5% of the BTSs into green BTSs.
- In some remote locations, the green energy is obtained by using biodiesel.

Thank You